Factual Report

Capsizing of New York State-Certificated Vessel *Ethan Allen,* Lake George, New York October 2, 2005

National Transportation Safety Board
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Abbreviations and Acronyms

CFR	*Code of Federal Regulations*
CO_2	carbon dioxide
COI	certificate of inspection
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
LGFD	Lake George Fire Department
OCMI	(Coast Guard) Officer in Charge, Marine Inspection
SST	simplified stability test
VCG	vertical center of gravity

Factual Information

Accident Narrative

On October 2, 2003, the operator of the *Ethan Allen* (**figure 1**) reported to Shoreline Cruises about 1000 to prepare for a 1-hour cruise on Lake George, New York, that was scheduled to begin at 1030.[1] Only two or three passengers boarded the vessel for the cruise.[2] The vessel had also gone out earlier in the day on a similar cruise under the command of another operator. Both cruises were uneventful.

Figure 1. *Ethan Allen* after the accident.

The operator was scheduled to operate a cruise later in the day with a group of senior citizens on a tour of the region. The group chartered the *Ethan Allen* and another Shoreline Cruises vessel, the *de Champlain.* Both 1-hour lake tours were to begin around 1500; however, the bus with the group scheduled for the *Ethan Allen* arrived at the marina early. Forty-seven members of the tour boarded and the vessel left the dock at 1430.

As the operator described, the tour was to be "our usual basic 1-hour cruise, take them up the west side of the lake, cross over, come down the east side on a return trip" (**figure 2**). The planned tour began from Lake George Village north to Green Harbour, a distance of approximately 3 miles. It was then to continue north along the west shore and

[1] All times are eastern daylight time, based on the 24-hour clock.

[2] Shoreline Cruises did not retain records of the number of passengers that boarded the *Ethan Allen* and its other comparably-sized vessels.

enter Green Harbour before crossing the lake to head back along the east shore. The 1-hour tour route crossed a zone in which speed was restricted to 5 mph or less, extending from a buoy off Fort William Henry up to Tea Island along the western shore. The accident occurred off Cramer Point, a point of land directly below Green Harbour.

Figure 2. Route of *Ethan Allen* on Lake George, New York, to accident site.

None of the passengers that the Safety Board interviewed recalled the operator providing a safety briefing during the voyage. New York State did not require operators of public vessels in its jurisdiction to provide safety briefings.[3]

Passengers sat on bench seats that were bolted to the vessel floor. There were eight rows of benches on the port and starboard sides of the vessel; each port side bench sat three passengers and each starboard side bench sat two. Two benches with seats for three passengers each on the port and starboard sides were located at the front of the vessel facing the bow. A third bench, the same width as the two-person starboard benches, was in the front of the vessel facing the bow. The operator's station was located aft of the benches on the starboard side. A framed wooden canopy enclosed the seating area and covered the benches. Plexiglas side windows, hinged at the canopy ceiling, opened upward. The windows were in the up position and hooked to the underside of the canopy for the voyage (**figure 3**). Passengers boarded and exited the vessel from the stern, port side.

[3] New York State defined commercial vessels operating on its navigable waters as "public vessels." See "Certification and Inspection" section for more information.

Figure 3. Three views of *Ethan Allen* interior, showing passenger seating, operator's station, windows, and canopy. Photos were taken after the accident.

After leaving the marina area, the operator increased the vessel speed from the 5 mph maintained in the no-wake area of the lower lake to 8 mph, its standard speed on the lake. The operator told investigators that with a relatively full passenger load, as he experienced on the accident cruise, the *Ethan Allen* was "maybe a bit slower to respond, [with] just minimal" differences in maneuverability between its fully and partially loaded conditions. He described vessel maneuverability as very good, even when fully loaded, and said that he had about "normal" freeboard.[4] The operator told Safety Board investigators that he had taken the *Ethan Allen* out several times each season with a full load of passengers.

As the vessel neared Cramer Point, some passengers observed a vessel traversing the lake to the right of the *Ethan Allen*, creating a wave that moved toward it. Witnesses varied in their identification of the particular vessel and in their descriptions of the size of the wave. One passenger described the wave as several inches high. A recreational boater, who observed the *Ethan Allen* from a 50- to 75-yard distance, reported seeing no wave strike the vessel. The *Ethan Allen* operator characterized the wave as 2 1/2 to 3 feet high. The wave was reported to have been on the starboard side of the *Ethan Allen*, moving from the bow toward the stern. As the operator told investigators,

> I always dip into that bay just a little bit, and I started to swing out, and I noticed this wave coming at me, good-sized wave. And I started to cut into it … [but] it caught me on the right side, starboard side back by the stern corner, and flipped it over to the left side, the port side.

[4] Distance from the vessel's deck to the surface of the water.

As a passenger described, the vessel, which had begun to heel to port, “never stopped rotating to the left along the axis of the boat.” As it continued to heel, passengers slipped off starboard side bench seats while those on the port side seats slid farther to the vessel’s port side.

The accident occurred at approximately 1454. Both the operator and survivors estimated that the vessel capsized in seconds. Survivors escaped through the open windows and clung to the overturned vessel on the surface. One passenger told investigators that she had initially been blocked by a Plexiglas window but was able to swim under it to escape the vessel.

Several recreational boats were in the vicinity. Many of the boaters observed the capsizing and immediately proceeded to the site, threw life preservers and flotation cushions to the survivors, assisted in rescuing survivors, or called 911 on their cell phones to report the accident. The capsized vessel then sank and came to rest upright on its keel in 59 feet of water, on the silt bottom of the lake.

Injuries

The injuries sustained in the Ethan Allen accident, shown in **table 1**, are categorized according to the injury criteria of the International Civil Aviation Organization (ICAO). The Safety Board uses the ICAO injury criteria in all its accident reports, regardless of transportation mode. Passengers listed as seriously injured remained hospitalized for more than 48 hours.

Table 1. Injuries to passengers and crew

Type of Injury	Crew	Passengers	Total
Fatal	0	20	20
Serious	0	3	3
Minor	0	6	6
None	1	18	19
Total	1	47	48

Title 49 *Code of Federal Regulations* (CFR) 830.2 defines a fatal injury as any injury that results in death within 30 days of an accident. Serious injury means any injury which (1) requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; **(**2**)** results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burns affecting more than 5 percent of the body surface.

Damages

The *Ethan Allen* sustained cosmetic damage to the hull and engine damage consistent with its being submerged. According to the Warren County (New York) sheriff's office, the vessel sustained an estimated $21,000 damage in costs associated with repairing the engine and other vessel damage. See "Wreckage" section of this report for additional information.

Personnel Information

The *Ethan Allen* operator, a senior captain with Shoreline Cruises, was 74 at the time of the accident. He graduated from high school in upstate New York, enlisted in the Army, and later joined the New York State Police, where he served as a trooper for 25 1/2 years. During his tenure with the state police, he served in the marine unit on Lake George, operating a state police boat.

In 1982, after retiring from the state police, he joined Shoreline Cruises. He obtained his New York State Master's License in 1984. The license, which stated that he was qualified to serve as "operator aboard public vessels operating upon the navigable waters of the State of New York," was valid through June 20, 2006. Shoreline provided its operators with additional training and experience beyond the minimum needed to meet State requirements, and it trained the operator to meet the qualifications to operate its larger vessels, in addition to the *Ethan Allen* and two similar vessels.

The operator was taking prescription medications for high blood pressure and cholesterol, as well as several over-the-counter vitamins at the time of the accident.

The operator told Safety Board investigators that he went to sleep by 2100 or 2130 the night before and arose by 0530 on the day of the accident, a schedule that he had maintained for at least several weeks before the accident. He typically left home around 0920 to arrive at the Shoreline Cruises office at least 30 minutes before the scheduled 1030 cruise. On the day of the accident, the operator conducted two cruises, one at 1030 and the accident cruise.

The owner of Shoreline Cruises, who had known the operator for over 20 years, considered him to be "extremely faithful" and a good worker who was punctual. He noted that the operator was "…always looking out for the safety of the public…[and was] a very conscientious person." The owner added, "…I don't have anything bad [that] I can say about that man."

Vessel Information

Construction

The main characteristics of the *Ethan Allen*, which was built in 1964, are listed below:

Registration:	NY1267FP
Hull form:	Dyer 40 fiberglass monohull
Length:	38 feet
Beam:	12 feet
Displacement:	<5 tons
Required crew:	1 joint pilot/engineer and 1 crewmember[5]
Passenger capacity:	48
Propulsion:	Cummins diesel engine, model 6BT5.9M, 210 horsepower
Propulsion type:	Conventional single-shaft, three-blade propeller, single rudder

The vessel had a fiberglass hull, with the main deck, bulkheads, and canopy made of wood. The area below deck was divided into four spaces: a forward space holding the 100-gallon fuel tank, a space serving as the engineroom, another space serving as the lazarette that contained the steering gear, and an aft port space for storage. The belowdeck spaces were accessed through the main deck hatch covers or, to access the lazarette, a side cover in the aft storage space. The vessel was not equipped, nor did New York State require that it be equipped, with a bilge alarm to alert crewmembers of a high water level in the bilge area, nor was there such a Coast Guard requirement when the vessel was built. Current Coast Guard small passenger vessel regulations require high

[5] In a November 14, 1986, policy memo, New York State called for vessels to have a second crewmember on board, in addition to the operator, when carrying more than 20 passengers.

level bilge alarms in engine spaces below the deepest load water.[6] New York State has not mandated such a requirement, but it has been proposed in draft form.

New York State regulations required public vessels between 26 and 40 feet in length to be equipped with at least a 10-gallon-per-minute bilge pump. The *Ethan Allen* was equipped with a bilge pump of the required capacity, mounted on the forward port bulkhead in the engine compartment, just below the deck. It could remove waste fluid from either the engine compartment itself or the space forward of that, according to the setting on a selector valve. However, in keeping with Lake George antipollution requirements, Shoreline Cruises practice was to have its crewmembers manually remove bilge waste into containers shoreside to avoid lake discharge from the onboard bilge pumps.

The *Ethan Allen* employed a "wet exhaust" system. Water was pumped from the lake through the engine's cooling circuit and into the exhaust gas piping by the main engine raw water pump. The mixture of exhaust gases and cooling water exited the vessel stern through a common pipe.

History

The first production Dyer 40 hull design was built in the early 1960s. The same hull design was used for the *Ethan Allen* and other applications.[7] In 1964, the Whaling Corporation Corporation (Whaling Corporation) of Groton, Connecticut, contracted with Anchorage Shipyard to build a fiberglass excursion vessel using the Dyer 40 hull design.

[6] See 46 CFR 182.530.

[7] The hull form has been used in a variety of other vessels as well, such as sport fishing vessels, lobster boats, yacht club tenders, cruisers, pilot boats, and U.S. Army Corps of Engineers utility boats.

The hull, the seventh in a series based on a design for 40-foot fiberglass cruisers, which would later be certificated by New York State as the *Ethan Allen,* was designated as Dyer 40-7. It was initially built at the Anchorage Shipyard and finished at Whaling Corporation. The Coast Guard Officer in Charge, Marine Inspection (OCMI), in New London, Connecticut, certificated the vessel on completion, and it was then named the *Double Dolphin*.

Based on information that Anchorage Shipyard provided, the *Double Dolphin* was in service for Whaling Corporation in 1965. In January 1966, Whaling Corporation contracted with Anchorage Shipyard for two additional vessels, requesting that the vessels be similar in construction, appearance, finish, and quality to the *Double Dolphin.* The three vessels were put into service and operated by Whaling Corporation until 1979.

According to the bill of sale, Shoreline Cruises acquired the *Double Dolphin* and the other two Dyer 40 vessels from Whaling Corporation on May 4, 1979. Although no documentation could be found to establish the dates and types of subsequent modifications, during its service in Connecticut, the *Double Dolphin* was modified with metal truss frameworks to support canvas canopies.[8] The Safety Board was unable to determine the type of metal or alloy in the frameworks. There was no evidence that the vessel was subject to a stability[9] reassessment following the installation of the metal frameworks and canvas canopies.

[8] With the exception of a Coast Guard certificate of inspection, the Safety Board was unable to obtain documentation on the vessel when it was registered as the *Double Dolphin.*

[9] The tendency of a vessel to remain upright or to return to its normal position when heeled.

Photographs of the three vessels taken after Shoreline Cruises acquired them show that the *Double Dolphin,* which Shoreline Cruises had renamed the *Ethan Allen,* and the vessel it renamed the *de Champlain* were equipped with full canvas canopies and metal frameworks, and the one it named the *Algonquin* was equipped with a partial canopy (**figure 4**). At that time, the *Ethan Allen* and the *de Champlain* were equipped with Plexiglas windows that could be held open or closed to enclose the passenger seating area.

Figure 4. Canopies and metal framework on *de Champlain* (foreground left), *Ethan Allen* (foreground center), and *Algonquin* (foreground right).

In 1989, Shoreline Cruises contracted with a boat builder in Albany, New York, to modify the *Ethan Allen* by installing an all-wood structure with Plexiglas windows that could be latched open.[10] The photograph of the vessel with the canvas canopy, compared with the actual wooden canopy that replaced it, indicates that the canvas canopy presented a larger surface area than the wooden one. Following the modification to the wooden canopy, the vessel was not subject to a stability assessment. Several years before the accident, Shoreline Cruises replaced the *Ethan Allen*'s Lathrop-manufactured engine with a six-cylinder, inline, turbocharged Cummins diesel engine.

New York State did not have regulations requiring State notification in the event of a major vessel modification, although the New York State "Public Vessel Operator's Manual" in effect at the time did require that the State be notified in the event of a major

[10] There were three 58-inch-by-36-inch windows on each side. Two additional side windows were 59 inches by 36 inches. Two bow windows, on the port and starboard sides, were 50 inches by 36 inches, while a forward window at the bow was 26 inches by 38 inches. Two fixed panes, on the port and starboard sides adjacent to the bow window, were 29 1/2 inches by 37 1/2 inches.

vessel modification. The method of notification, whether verbal or in writing, was not specified.[11]

Certification and Inspection

The Coast Guard OCMI, Providence, Rhode Island, approved the initial construction plans for the D*ouble Dolphin*, which was to be certificated as a small passenger vessel. The hull was delivered to its original owner in July 1964 partially completed and was inspected by the Coast Guard OCMI in Providence. A Coast Guard certificate of inspection (COI) was not issued at the time because the vessel was not fully completed.

OCMI Providence passed the *Double Dolphin* inspection to OCMI, New London, Connecticut, for final approval when the vessel was completed. It is believed that the Coast Guard OCMI in New London issued a COI to the *Double Dolphin* in 1964, although the Safety Board was unable to verify this.

Anchorage Shipyard, in a February 22, 1966, a letter to the Coast Guard OCMI, Providence, Rhode Island, supplemented a "Request for Inspection" for two 40-foot excursion launches for Whaling Corporation, based on the previous Coast Guard approval of the *Double Dolphin*. The Coast Guard OCMI, Providence, approved the submitted plans in a letter dated March 1, 1966, and recognized the *Double Dolphin* as

[11] New York State policy was to retain records for 5 years. As a result, in the event that it been notified of the canopy modification, there were no records available to verify it.

the original "sister."[12] The three hulls were later referred to as Dyer 40 hulls 40-7, 40-8, and 40-9.[13]

Shoreline Cruises provided the Safety Board with a copy of a May 28, 1976, COI that the Coast Guard issued to the *Double Dolphin,* as well as the COIs the Coast Guard issued to the two other vessels acquired from Whaling Corporation. The *Double Dolphin* COI referred to a stability letter dated May 27, 1966.[14] A stability letter would have included operating conditions in which the vessel would have satisfactorily demonstrated stability and would have indicated how the vessel's stability had been assessed.[15]

The Safety Board interviewed Whaling Corporation employees who said that they observed a stability test on a Whaling Corporation vessel. However, because it was unable to obtain documentation governing the nature of the vessel's certification and stability assessment, if any, the Safety Board was unable to verify that the Coast Guard had subjected the *Double Dolphin* to an actual stability assessment. The Coast Guard COIs for the other two vessels contained no information on the item labeled "Stability letter (date and time)."

Because it was built in 1964, 46 CFR Subchapter T, effective on September 6, 1963, applied. Those Coast Guard rules did not require stability tests for passenger

[12] As described in to Chapter 6D, *Coast Guard Safety Manual*, "The following general guidelines have been developed to provide guidance and to help keep the determination of 'sister vessel' as uniform as possible: the previously inclined vessel hand the proposed sister vessel should have been built within approximately 2 years from one another; the vessels must be built by the same shipyard; and the same basic drawings should have been used in the construction of both vessels." Coast Guard Navigation and Vessel Inspection Circular No. 14-81 contains additional information on this topic.

[13] The hulls have also been referred to as Anchorage hulls 40-7, -8, and –9.

[14] The Safety Board was unable to locate a copy of the letter.

[15] Title 46 CFR 179.20 Stability Letter (1960 Rules and Regulations).

vessels that were shorter than 65 feet in length and that carried fewer than 50 passengers. Rather, at that time, the OCMI could require a stability test to be performed if he or she believed that it was necessary to demonstrate the vessel's stability under the expected operating conditions that the owner had specified. The OCMI could accept alternatives, equivalents, or departures from standards if it could be shown that these were warranted under the circumstances. The OCMI could also apply restrictions or contingencies to a vessel's operation, which would have been listed on a vessel's COI, if he or she deemed them necessary for safety.

Had the OCMI required it, the initial stability assessment would have been a simplified stability test (SST), in accordance with 46 CFR 179.10, "Stability Test Procedure" (Rules and Regulations 1963).[16] On March 10, 1996, the Coast Guard revised 46 CFR Subchapter T, requiring all small passenger vessels carrying more than six persons to pass an SST or an inclining test with rigorous stability calculations demonstrating compliance with passenger vessel stability requirements of Subchapter S.

Shoreline Cruises renamed the two vessels it acquired with the *Ethan Allen* from Whaling Corporation the *de Champlain* and the *Algonquin* when it moved them to New York State for Lake George operations. All three vessels became subject to New York State rather than Coast Guard jurisdiction at that time because Lake George operations fell within New York State's jurisdiction. Under New York State regulations, the *Ethan*

[16] See 46 CFR Subchapter T, "Small Passenger Vessels (Under 100 Gross Tons)." Subchapter T was promulgated in 1957 as a result of Public Law 519, enacted following the September 1, 1951, capsizing of the M/V *Pelican* off Long Island, New York. The small commercial fishing vessel, which was designed to safely accommodate 30 persons, was carrying 64 people when it capsized in heavy seas. Because of the vessel's overloaded condition, the sea state, and the failure of the boat's occupants to don lifejackets, 45 people died. The subchapter specifies programs, policies, documents, and equipment that vessels under 100 tons are required to follow or carry on board.

Allen and the other two vessels were considered "public vessels," a category of powered vessels transporting either passengers or freight for commercial purposes on New York State waters. The State-issued COI specified the maximum number of passengers permitted and the number of required crewmembers that vessels were licensed to carry. State inspectors examined public vessels annually and required discrepancies to be corrected before they would issue State COIs.

New York State representatives indicated that the State accepted the original Coast Guard COI and did not require a stability assessment upon the *Ethan Allen*'s entry onto State waters or after the vessel's canopy modification into a wooden structure. New York State's most recent COI for the *Ethan Allen* was issued on May 23, 2005. The State-issued COI, given after an inspection, specified the maximum number of passengers permitted and the number of required crewmembers that vessels were licensed to carry. The State COI permitted a maximum of 48 passengers on the *Ethan Allen* and required a captain and a crewmember when carrying more than 20 passengers. This was similar but not identical to the limitations on the Coast Guard's vessel COI dated May 28, 1976, which required a captain and second crewmember irrespective of the number of passengers carried.

State inspectors examined public vessels annually and required discrepancies to be corrected before they would issue State COIs. A New York State Office of Parks, Recreation and Historic Preservation official estimated that the State inspected about 300 public vessels annually.

Maintenance

Shoreline Cruises maintained its vessels with its own personnel, except when extensive engine repairs were needed. The company required operators to check their vessel's engine fluids and bilge levels at the beginning of each day. Occasionally, company maintenance personnel would perform similar checks to verify vessel and engine status that the operators reported.

Shoreline Cruises replaced the *Ethan Allen*'s main engine raw water pump around July 12, 2005. According to the Shoreline Cruises owner, this was done upon the recommendation of the company's maintenance technician after he noticed leaking at the internal water seal. New York State did not require owners of vessels of that size to maintain a log of maintenance actions, and Shoreline Cruises did not maintain such a log for maintenance performed on the *Ethan Allen.*

Lifesaving Apparatus and Safety Equipment

New York State required the *Ethan Allen* to carry sufficient lifesaving equipment on board for 50 people. The vessel was equipped with the following safety equipment:

Adult lifejackets	50 type I
Child lifejackets	5 type I
Fire extinguishers	One portable 5-pound carbon dioxide (CO_2) and one portable 44-pound CO_2
Ring buoys	One type IV throwable device

Adult lifejackets were stowed inside a cabinet located near the operating console at the vessel's stern and secured by an unlocked latch. Children's lifejackets were located inside a wooden box, the top of which formed the seat of a 36-inch bench, located at the

vessel's bow. Both adult and children's lifejacket storage locations were clearly marked.[17] The 5-pound fire extinguisher was located near the operating console and the 44-pound one was located inside the engine compartment. Both were portable extinguishers.

Wreckage

Investigators examined the vessel after it had been recovered from Lake George and brought to shore. No damage was noted on the fiberglass outer hull, rudder, skeg, propeller, or drive shaft components. A bow port side window and midship starboard side window were missing. All passenger benches were found bolted to the main deck and free of damage. The hatch cover over the engine was missing but was later returned to investigators by boaters who had recovered it from the lake. The exterior of the main engine was free of damage. The engine was considered to have sustained internal damage after it either ingested water or lost lubrication while it briefly operated inverted immediately following the capsizing.

The vessel was then launched and allowed to float for about 20 minutes to determine whether hull leaks were present. None were found. Several pinhole leaks were found in the engine exhaust pipe and several weld beads, suggestive of previous repairs, were noted in the general area of those leaks. The brother of the owner of Shoreline Cruises claimed that during postsalvage inspection of the vessel, he slid and fell into the forward end of the engine compartment and onto the pump.

[17] Coast Guard regulations (46 CFR 180.78) require lifejackets to be stored "in convenient places distributed throughout accommodation spaces." New York State Navigation Law 2 (67) requires life preservers to be located in "convenient, accessible places."

The main engine raw water pump was bolted externally to the port forward end of the engine. This pump was located above the vessel's waterline when fully loaded with passengers. A gap, which measured 0.076 inches at the widest point, was found between the pump base and its impeller housing. When the raw water pump was removed from the engine, it was observed that one of the two bolts on its mounting flange was backed out 0.063 inches and was loose to the touch.

No indications of engine damage were visible, other than those observed in the raw water pump. No signs of wear, holes, or abrasions were found in the engine compartment hoses or piping. The entire engine space and the engine exterior were coated with what appeared to be lubricating oil, believed to be a consequence of the capsizing. The vessel's two 12-volt batteries were found cabled together and dislodged, resting over the exhaust pipe, about 3 feet aft of the engine.

The bilge pump selector was found positioned to the forward space. Twenty-one lead bricks, each weighing about 55 pounds, were found unsecured in the belowdeck forward space, near the 100-gallon fuel tank. Fourteen bricks were found under the fuel tank's plywood support; the remaining seven were found in different locations on the port side in that space. The movement of the bricks during the capsizing appeared to have caused minor cosmetic damage to the space interior.

Waterway Information

Lake George, located at the southernmost end of New York's Adirondack Park region, is 32 miles long and nearly 3 miles across at it widest point. The maximum lake depth is 195 feet. Over 10,000 boats of varying sizes operate on the lake each year.

Public vessel operations on the lake are conducted under regulations established by the New York State Office of Parks, Recreation and Historic Preservation. The Lake George Commission, which also issues marina and special activities permits, provides law enforcement services on the lake, as does the New York State Police–Marine Unit on Lake George and the Warren County sheriff's office.

Meteorological Information

The Lake George water temperature was 68° F at the time of the accident. Witnesses consistently described the water as calm, except for areas near other vessels affected by waves created by vessel wakes.

The National Weather Service office in Albany, New York, issued no hazardous weather advisories for the area on the day of the accident. Weather observations at Floyd Bennett Memorial Airport in Glens Falls, New York, about 6 miles east-southeast of the accident site, were taken both before and after the accident. At 1353, 1453, and 1553, the following conditions were included in the recorded weather observations:

> Wind calm, visibility unrestricted at 10 statute miles, sky clear, temperature 71° F.

Medical and Pathological Information

Medical Information

Autopsies were performed on each of the 20 fatalities in the accident, in accordance with New York State requirements. All victims were determined to have died as a result of asphyxia due to drowning. The Safety Board examined the results of the

autopsies. Most of the drowned passengers were found to have significant injuries, including rib fractures and head and neck injuries. Survivors were either uninjured or had minor injuries.

Six of the fatally injured passengers had no significant injuries. Four of those showed evidence of significant coronary artery disease**.**

Toxicology Testing

New York State did not require postaccident toxicological testing of mariners. Under State law, following a marine accident in which a passenger was seriously or fatally injured, a law enforcement official or the local District Attorney could request a state superior court judge to compel toxicology testing through a court order, if he or she believed this was warranted.

The Warren County sheriff personally observed the operator shortly after the accident, found no evidence of impairment, and did not ask for court-ordered toxicology samples to be obtained. According to the owner of Shoreline Cruises, who observed the interaction,

> I drove over to see [the] sheriff[‘s] boat…and [the sheriff] did go over to … [the operator] I see him talk to him, and when he talked to him, his face was probably six inches away from … [the operator]’s face. When … [the sheriff] came back to me after that he said, he said “I feel confident now.” And with that he said … “[the operator] is okay.”

The operator and the sheriff then proceeded to the Shoreline Cruises office, where the operator gave an account of the accident to the sheriff. The operator spent 1 to 1-1/2 hours with the sheriff answering questions about on the accident.

At the request of the Safety Board, 2 days after the accident, the operator voluntarily submitted blood and urine samples for toxicological analysis. He told Safety Board investigators that he had consumed a glass of wine with his dinner the night before the accident but had not consumed any alcohol from that time until he provided the samples for toxicological analysis. The samples were sent to the Federal Aviation Administration (FAA) Civil Aerospace Medical Institute for analysis. The samples were negative for legal and illegal drugs. A level of 5,330 nanograms per milliliter of ethyl glucuronide, a product of the metabolism of alcohol, was found in the operator's urine.[18]

Survival Aspects

Emergency Response

Several people on boats and on shore saw the capsizing and quickly called 911 on their cell phones. Warren County sheriff's office logs indicate that these calls took place at 1454. Lake George Fire Department (LGFD) records indicate that the first units were dispatched at 1456 and arrived at 1504. The LGFD fire chief established an onshore incident command post near Cramer Point and served as the incident commander for the response to the accident.

[18] Ethyl glucoronide can be detected in urine for up to 80 hours after the elimination of alcohol from the body.

A total of 49 emergency response vehicles and vessels were dispatched to the scene. In addition, recreational boaters who observed the accident immediately went to the scene to assist in the rescue. A group of divers at a Lake George dive school saw the capsizing and also called 911 to report the accident. The divers advised the dispatch center that they were waiting to assist the rescue but needed boats to take them to the site. About 15 minutes later, a recreational vessel took five dive instructors to the site. Three stayed on the surface assisting and two participated in the victim recovery.

Ambulances transported survivors to a hospital in Glen Falls, New York. The operator was uninjured and elected not to be taken to a hospital. Eighteen survivors were treated for minor injuries or exposure to cold and released the same day. One was admitted overnight, treated for stress and exhaustion, and released the next day; five were admitted and discharged after 2 nights; and three were discharged after 3 nights. Their injuries included water aspiration, hypothermia, possible myocardial ischemia, chest pain, and shoulder trauma.

The Safety Board obtained the weights of those on board the vessel.[19] The average weight was 177.5 pounds, with a range from 110 to 268 pounds. The total weight of those on board the *Ethan Allen* was 8,522 pounds. The ages of the passengers ranged from 54 to 89 years, with the mean being 74.4.[20]

[19] The coroner supplied the weights of fatally injured passengers. Surviving passengers and the operator provided their weights at the Safety Board's request.

[20] See appendix B for more information on the age, sex, weight, and location of each passenger.

Survivability-Related Rules

At the time of the accident, New York State did not require a predeparture safety briefing or that a safety card or pamphlet providing safety-related information be made available to passengers. Coast Guard rules, at 46 CFR 185.506, required the operator to ensure that, before getting under way, an announcement was made, or that a pamphlet or card communicated to all passengers the following information:

- The location of emergency exits and ring life buoys.
- The locations of lifejackets.
- The proper method of donning or adjusting lifejackets—including a demonstration of proper donning.
- The location of instruction placards for lifejackets and other lifesaving devices.
- A requirement that passengers don lifejackets when possible hazardous conditions exist, as directed by the master.

New York State did not have a rule specifying minimum dimensions associated with means of escape; however, its "Technical Guidance for the Public Vessel Operators–New York State Office of Parks, Recreation and Historic Preservation," required public vessels to have two means of egress on each level occupied by passengers. The minimum opening for doorways was required to be 32 inches and for windows, 24 inches. On March 2, 2006, the Governor of New York issued a press release

calling for legislation to "Require all public vessels certified to carry 20 or more passengers be equipped with at least two means of exit on each deck…"[21]

Tests and Research

Raw Water Pump—Manufacturer's Facility

On December 20, 2005, Safety Board investigators tested the *Ethan Allen*'s raw water pump at the facilities of the engine manufacturer. A pump that was identical to that found on the *Ethan Allen* was used in place of the actual pump to avoid potential damage (thereby preventing further examination) and connected to an identical engine in a test cell. The test cell was configured to replicate the operating conditions on the *Ethan Allen* in the following conditions:

- The raw water temperature was matched to that of the lake at the time of the accident.
- The raw water inlet plumbing was configured to replicate the theoretical raw water inlet restriction calculated from the *Ethan Allen*'s actual plumbing.
- The raw water inlet plumbing was configured to allow the adjustment of waterline height in relation to the pump centerline to simulate the unloaded and loaded vessel conditions.
- The engine was coupled to a dynamometer to replicate the theoretical load on the engine at the time of the accident.

The engine with the installed pump was then operated under several test conditions to assess the pump's operational characteristics. Investigators then introduced

[21] See appendix C.

a 0.076-inch gap in the pump housing to match that found on the vessel at its widest point. The following results were obtained:

- The pump was unable to establish prime when starting the engine with the gap in place.
- Initially, the engine was running with no gap in the pump. Immediately after the gap was introduced, the pump completely lost flow.
- While operating with no water flow, internal friction within the pump caused the impeller and housing to overheat and emit white smoke.
- With the pump not supplying water flow through the engine's cooling system and the engine running within routine operational parameters, the engine operated 4 minutes before it overheated and had to be shut down because of high cooling water temperature.
- The maximum leak rate during any testing phase was 0.2 to 0.3 gallons per minute.

Raw Water Pump—Laboratory Testing

After the accident, the pump assembly was examined in the Safety Board's materials laboratory. Safety Board laboratory staff found that the three hex head bolts holding the pump housing in place were visibly backed off the pump housing and the helical lock washers were free to rotate. The underside of the housing bolt heads did not display the distinctive curl of material produced when a tight bolt is loosened (a feature that was consistently produced by testing of exemplar bolts at the manufacturer's specified torque loading), but the underside did show a smearing of the plated surface. On the pump surface, adjacent to the lock washer, one bolt location displayed lock washer

contact and one displayed lock washer contact on the identification tag that was located between the pump surface and the lock washer. The wear plate, installed between the pump base and the pump housing, displayed a well-defined imprint of an O-ring on the pump housing contact face and a well-defined imprint of a paper gasket on the pump base contact face, indicating that they had been secured and evenly compressed at one time. The wear plate surface contacted by the impeller was discolored, and the impeller tip showed evidence of wear.

On January 10, 2006, three raw water pumps were examined at the Safety Board's materials laboratory. One pump had been on the *Ethan Allen* at the time of the accident, one had been on the vessel until that pump replaced it about 3 months before the accident, and the third was the exemplar pump tested at the manufacturer's facility on December 20, 2005. All three pump housing bolts from the pump on the *Ethan Allen* at the time of the accident were loose, with the lock washer free to rotate on the bolt. Lock washer contact was observed around two of the three pump housing bolt holes located on the bearing housing. The lock washer contact face on the bolts displayed limited plating removal and circumferential scratches. The scratches were consistent with the bolt being in contact with the lock washer, but there were no indications that it had been loosened.

As a test, exemplar bolts and lock washers were torque-loaded, in accordance with the manufacturer's specification, and then loosened. Subsequently, investigators noted a distinctive curl of material on the surface, consistent with the loosening action under the head of the exemplar bolts, under close examination. Despite the gap between the pump and bearing housings, with the wear plate between them, one side of the wear plate displayed a uniform imprint from the O-ring in the pump housing and the other side

displayed a uniform imprint from the gasket between it and the bearing housing. The impeller contact face on the wear plate was severely discolored, with significant wear found on the impeller tips relative to the condition of the other two pumps.

On all three pump housing bolts on the exemplar pump, investigators found loosening contact marks from the lock washers and wear on the impeller tips. Significant wear around the pump housing bolt holes, consistent with repeated tightening and loosening of the housing bolts, was found on the previously installed *Ethan Allen* pump. The impeller shaft of that pump was extremely loose in the bearing housing and there was significant wear on the shaft's key slot, the key, and the impeller keyway. The impeller tips showed negligible wear.

On-site Stability Assessment

The Coast Guard SST verifies a vessel's intact stability for carrying passengers. The number of passengers to be carried is initially determined before the test is conducted, based on a review of the vessel's drawings or physical measurements, using one of several criteria.[22] The number of passengers permitted according to the resultant calculations is then determined, based on Coast Guard criteria of 140 pounds per person for vessels to be operated on protected waters.

The SST protocol includes calculating wind and passenger heeling moments to determine whether a vessel, as built and proposed to be operated, has the required

[22] *Length of rail*—one passenger for each 30 inches of rail at the sides and stern. *Deck area*—one passenger per 10 square feet of deck area, excluding spaces listed in 46 CFR 176.113, which include, among other areas, concession stands, toilets, lifesaving gear storage spaces, required aisle area, and fixed seating areas. *Fixed seating*—one passenger for each 18 inches of fixed seating width.

minimum stability and reserve buoyancy. The calculated wind or passenger moment that is greater is applied to the vessel and the vessel's loss in freeboard is then determined. The calculation of the passenger heeling moment is based on the beam of the vessel and the number of passengers carried, while that of the wind heeling moment is based on the projected lateral surface of the vessel exposed to wind pressure.

The physical proof test simulates a full vessel passenger load using the number of passengers allowed by the vessel design and the number of required crewmembers, multiplied by the weight standard. If the vessel's loss of freeboard from heel with this load is greater than that stipulated in the standard, it is not permitted to carry the number of passengers determined initially. The owner must then reduce the heeling moment to enable the vessel to pass the proof test, by reducing the maximum permitted number of passengers, ballasting the vessel, or reducing the vessel's wind profile area, if possible. The owner could also show, by an inclining test and design calculations, that a vessel's loading and operation meet the stability criteria of 46 CFR Subchapter S.

During the period in which the vessel was under its jurisdiction, the Coast Guard issued a COI that was valid for 3 years after an OCMI had determined that the vessel demonstrated the necessary stability and complied with applicable regulations. The Coast Guard required the vessel to be reinspected annually on each of the two anniversary dates of the issue of the initial COI. During the reinspections, the vessel was subject to less-detailed inspection criteria than those used in the initial inspection, unless the inspector noted deficiencies that would have caused him or her to expand the scope of the inspection.

After the accident, Safety Board investigators conducted a series of stability-related tests on the *de Champlain,* which investigators considered for test purposes to match critical dimensions of the *Ethan Allen.*[23] The first test was an SST, designed to assess the vessel's ability to avoid exceeding a specified freeboard immersion created by heeling the vessel to the greater of either wind or passenger heel moments, in accordance with 46 CFR 178.330, Simplified Stability Proof Test.[24]

The vessel's fuel tank was filled to three-quarters full to match the level specified in the Coast Guard job aid and Coast Guard regulations, and passenger benches were repositioned to facilitate the movement of the test weights.[25] The test weights were placed on the vessel's centerline to provide normal operating trim and to simulate the operating vessel's vertical center of gravity (VCG). The Coast Guard job aid required that the test weight used in a stability proof test have a VCG of 2.5 feet.[26] In the test SST, the test weights were placed on blocks to produce this VCG.

The freeboard and the lateral area exposed to wind were measured with the vessel carrying the test load. Passenger heel and wind heel moments, as well as immersion of the freeboard, were calculated. The test conditions are shown in **table 2**.

[23] Safety Board investigators compared the two vessels and found the general arrangement and construction of the hulls to be the same with some minor differences in ballast, canopy structure, type of main engine, and outfitting noted and accounted for in the tests.

[24] Coast Guard specifications were used because New York State applied Coast Guard stability requirements to public vessels.

[25] Twelve 55-gallon barrels, which were mounted on wooden blocks.

[26] The 1979 version of the job aid (Coast Guard-4006, REV. 6-79) was used.

Table 2. On-site SST test conditions

Passenger Heel		Wind Heel		Allowable Immersion	
Test Weight (calculated)	**Moment**	**Lateral Wind Area**	**Moment**	**One-half Freeboard**	**14º Limit Angle of Heel**
6,720 pounds	11,659 foot-pounds	330 square feet	13,060 foot-pounds	17.5 inches	17.16 inches

Investigators initially filled 12 55-gallon barrels with water, positioned them on the vessel's centerline, and took initial freeboard measurements. This would have produced a test weight that would have replicated loading 48 passengers with an average per person weight of 140 pounds.[27] To reach the maximum heeling moment of 13,060 foot-pounds, eight of the 12 barrels were emptied and repositioned against the vessel's port side, in a two-by-four combination, with the intent of filling all eight barrels to produce the required heeling moment. However, after filling only three outboard barrels, the vessel heeled to within 3 inches of the reference immersion mark, for a moment of about 7,164 foot-pounds. Investigators noted that the vessel felt tender[28] and terminated the test rather than risk capsizing the vessel by filling the remaining empty barrels (**figure 5**).

Figure 5. *De Champlain* after on-site stability assessment was terminated.

Investigators then conducted an inclining test on the *de Champlain* to determine its VCG. The test measured changes in the equilibrium heel angle of the vessel after moving water barrels, each weighing 477 pounds, transversely to various positions on the

[27] Calculated from the SST job aid for wind heel, for the SST conducted on the *de Champlain*.

[28] A vessel is described as "tender" when its center of gravity is too high, making it top-heavy and "conducive to capsizing" (*International Maritime Dictionary*).

main deck. The test also derived the vessel's lightship condition (displacement)[29] by adding, deducting, or relocating all items on the inclined vessel.[30] At the time of the inclining test, the wind was slack and wave action on the lake was minimal. The maximum inclination was found to be about 3º. The results of the inclining experiment were recorded on the sample data form attached to ASTM Standard F 1321-91[31] (see **appendix D)**.

Both the *de Champlain* and the *Ethan Allen* were then placed in the water. The *Ethan Allen* measured a consistent 0.5 inch deeper in the water than the *de Champlain.* Both vessels were then placed on a New York State Police-certificated truck scale and weighed. The *de Champlain* weighed 14,850 pounds and the *Ethan Allen*, 15,300 pounds. Among other differences, the *de Champlain* also had an additional 55 pounds of lead ballast blocks and lacked about 100 pounds of water survey equipment that the Lake George Association had provided to the *Ethan Allen.*[32]

[29] The vessel condition that is complete in all respects but is without consumables, stores, cargo, crew, or passengers and has only operating fluids in the vessel's machinery.

[30] Both the vessel's lightship weight and the center of gravity are necessary if the vessel's stability is to be calculated according to 46 CFR Subchapter S standards. In addition, 46 CFR 178.320 (e) allows an owner to perform rigorous stability calculations if the SST fails.

[31] "Standard Guide for Conducting a Stability Test to Determine the Light Ship Displacement and Centers of Gravity of a Vessel."

[32] The equipment was used for water resource management classes that the Lake George Association conducted on that vessel.

Postaccident Stability Study—Method

The Safety Board contracted with JMS Naval Architects and Salvage Engineers to derive the static and dynamic stability of the *Ethan Allen* in both the intact and flooded conditions.[33] To conduct this, the contractor was to perform six tasks:

1. Develop an accurate computer model of the *Ethan Allen* hull form.
2. Calculate the lightship weight and VCG *Ethan Allen* at the time of the accident, based on the inclining experiment conducted on the *de Champlain.*[34]
3. Calculate the *Ethan Allen* lightship weight and VCG for previous vessel conditions—as delivered by the builder and with several canvas canopy versions.
4. Determine the maximum passenger loading that would meet Coast Guard simplified stability criteria in 46 CFR 178.330, based on the lightship weights and VCGs found in tasks 2 and 3.
5. Determine the maximum passenger loading that would meet Coast Guard stability criteria in 46 CFR Subchapter S, 46 CFR 170.170, 46 CFR 170.173, and 46 CFR 171.050, based on the lightship weights and VCGs found in tasks 2 and 3.
6. Evaluate the effects of transverse passenger movement and internal flooding of the main engine and forward compartments on vessel intact stability.
7. Evaluate the effects of wave action at various angles of incidence, and the effects of vessel turning on dynamic stability.

[33] Intact stability assumes no damage to or flooding of the vessel. Static stability is a measure of the vessel's stability characteristics in calm water. Dynamic stability is a measure of a vessel's characteristics and response to external forces such as wind and waves.

[34] See "On-site Stability Assessment" section.

Before beginning its study, the contractor performed a laser survey of the *Ethan Allen* to develop the hull form. The contractor then used the results of the laser survey to generate a three-dimensional computer vessel model to import into naval architecture software for use in the stability analysis.[35] The tested vessel conditions were as follows:

- As it was when delivered from the Anchorage.
- With the steel canopy installed—operated in fresh water.
- With the steel canopy installed—operated in salt water.
- With the aluminum canopy installed—operated in fresh water.
- With the aluminum canopy installed—operated in salt water.
- With the wood canopy installed—operated in fresh water.

Postaccident Stability Study—Results

The *Ethan Allen* hull form that the contractor created as task 1 is shown in **figure 6**.

Figure 6. Computer-generated *Ethan Allen* hull form.

Estimates of the *Ethan Allen*'s lightship weight and longitudinal center of gravity at the time of the accident were based on the weight measured on the truck scale and from freeboard measurements taken while the vessel was afloat. The VCG was derived from the results of the *de Champlain* inclining test. The hydrostatic properties based on task 1 were used for both vessels.

[35] Analysis used "HECSALV," proprietary software developed by Herbert Engineering Corp.

In tasks 3 through 5, the contractor calculated passenger vessel stability in accordance with Coast Guard regulations in 46 CFR Subchapters S and T, in various vessel configurations, three canopy designs,[36] and both salt and fresh water, since the vessel had operated in both. For the SST, assumed centers of gravity 2.5 feet and 1.5 feet above the deck were used for the VCG of passengers.

Lightship weights and centers of gravity of the five types of vessel configurations are shown in **table 3**. The *de Champlain* is included for comparison purposes, using the results of the October 5, 2005, inclining experiment.

Table 3. Lightship conditions of alternate vessel configurations

Item	***Ethan Allen* 1964**	***Ethan Allen* Steel Canopy**	***Ethan Allen* Aluminum Canopy**	***Ethan Allen* 2005**	***De Champlain* 2005**
Weight (pounds)	12,759	14,590	13,542 s	14,689	14,315
VCG (feet above baseline)	4.5 f	5.4	4.9	5.3 f	5.4
LCG (feet aft of forward perpendicular)	19.4	19.5 f	19.4	19.5	19.8 f

The task 4 stability analysis showed that the only version of the *Ethan Allen* (or of the *Double Dolphin*) that passed the SST, regardless of the number of passengers being considered, was the one with no canopy. With the canopy installed, the wind heeling moment was found to govern over the passenger heeling moment.[37] The marginal stability finding was similar to that discerned in the on-site inclining test performed on the *de Champlain*, where it was demonstrated that approximately half of the required

[36] Canvas canopy with schedule 40 steel frame, canvas canopy with schedule 40 aluminum frame, and wooden canopy.

[37] That is, it became the more severe of the two stability criteria that the vessel had to meet. Thus, if the vessel met the wind heeling moment, it met the passenger heeling moment as well.

heeling moment was imposed before the test was halted, when the vessel was close to the minimum freeboard.

The results of task 5—maximum passenger loading for Subchapter S criteria—are shown in **table 4**. As noted, passenger counts were based on 140 pounds per person, the Coast Guard standard for protected waters. As in the simplified criteria, no metal-framed canvas canopy was found to meet the wind heel criteria, regardless of the total passenger count. The wood canopy was found to meet the criteria with a reduced number of passengers, because the height of the wood canopy was lower than the height of the canvas one. Thus its vertical center of gravity was lower and it offered a smaller wind profile than did the previous canvas canopy.

Table 4. Maximum passenger loading for Subchapter S stability criteria

Condition	46 CFR 170.170 Wind Heel		46 CFR 170.173 Unusual Form		46 CFR 171.050 Passenger Heel	
	Weight (pounds)	Passengers (number)	Weight (pounds)	Passengers (number)	Weigh (pounds)	Passengers (number)
1	>21,000	>150	8,260	59	8,120	58
2	DID NOT PASS		1,540	11	6,860	49
3	DID NOT PASS		1,400	10	6,720	48
4	DID NOT PASS		5,180	37	7,560	54
5	DID NOT PASS		5,040	36	7,560	54
6	2,940	21	1,960	14	6,860	49

NOTE: Weight = total weight of passengers at 140 pounds per passenger.

In task 6, the Safety Board examined the effects of the three-by-two passenger seating configuration on the vessel's center of gravity, given the weight of those on board the vessel. The results indicate that the total passenger (and crew) transverse center of

gravity was 0.2 feet to port of centerline and the longitudinal center of gravity was 0.36 feet forward of midship. This created a 2.2º heel to port and 0.71-foot trim forward.

The effect of transverse movement of the passenger load was also analyzed, because survivors reported that as the vessel rolled to port, passengers slid to the vessel's port side. The transverse weight shift was found to have no effect on metacentric height (GM), but it did increase heel and reduce the vessel righting arm. In the accident condition, the righting arm disappeared with the passenger weight shifted 1.0 foot off centerline, or 0.8 feet from the initial loading condition (**table 5**).

Table 5. Transverse passenger weight shift to eliminate *Ethan Allen* righting energy

Number of Passengers Shifting	Distance Moved to Port (feet)
48	0.8
30	1.25
20	1.9
7	5.5

Additional Information

Capacity Plate Standard

At the time of the accident, New York State oversaw 447 public vessels, ranging from 9-foot personal watercraft carrying three passengers to a 40-foot Crestliner carrying 35 passengers. The passenger capacity of most of the vessels was determined by the manufacturer's capacity plate attached to the boat.

New York State did not have regulations governing stability assessments for public vessels. It accepted either a Coast Guard-approved stability assessment or a

manufacturer's capacity plate as evidence of acceptable vessel stability, or it conducted its own stability assessments using Coast Guard passenger vessel stability requirements. Of the 447 public vessels registered in the State, 382 used capacity plates as determinants of the number of passengers permitted on the vessels. Of those, 125 carried more than six passengers (**table 6**).

Table 6. Criteria for determining passenger capacity of New York State public vessels

Criteria Used to Determine Passenger Load	Number of Vessels
Deck area	6
Fixed seating	31
Combination of fixed seating and deck area	2
Manufacturer's capacity plate	382
Stability assessment	20
Other means	6
Total	**447**

New York State applied Coast Guard capacity plate data to determine the number of passengers permitted on public vessels. New York State Marine and Recreational Vehicles Law, §71-c (3), made this procedure explicit:

> In prescribing such methods and formulas, the department shall be guided by and give due regard to the necessity for uniformity in methods and formulas lawful for use in determining vessel capacity in the several states and to any methods and formulas which may be recognized or recommended by the United States Coast Guard, or any agency successor thereto.

Capacity plate data used by New York State were based on Coast Guard specifications found in 33 CFR 183, Subpart B—Display of Capacity Information. This standard applied to monohull boats less than 20 feet in length, except sailboats, canoes, kayaks, and inflatable boats. Vessels longer than 20 feet were not required to list capacity

requirement, although many manufacturers meet the minimum requirements contained in 46 CFR 183.

In August 1972, the Coast Guard promulgated rules that specified the number of passengers that recreational vessels under 20 feet (except sailboats, kayaks, canoes, kayaks, and inflatable boats) could carry in terms of a total number of pounds that could be safely transported. In January 1980, the Coast Guard changed its rules to require that the maximum number of persons permitted on a vessel, in addition to the total weight permitted on a capacity plate, be displayed on the vessel.

The Coast Guard determined, using survey data of recreational boat loading, that the passengers typically represented on a boating outing were composed of a mix of adults and children. It proposed a formula, based on the survey data, to calculate the maximum allowable number of persons permitted on recreational boats.

New York State Vessel Operator Regulations

Operators of New York State public vessels were required to obtain one of three types of public vessel operating licenses, according to their experience level and/or the type of vessel operated. Those training to earn a master's license obtained an "apprentice operator" category license, an entry-level category. Operators of vessels 65 feet long or greater, carrying 65 or more passengers, or displacing 50 or more tons were required to obtain a State operator's license, while those operating smaller vessels needed to obtain a "joint pilot and engineer" license. Engineers on vessels that required a person dedicated to operating the propulsion system obtained State engineer's licenses. Vessel operators were required to demonstrate both knowledge of vessel regulations and operating

principles and proficiency in handling the vessel on the waters in which the vessel was being operated.

Oversight of Commercial Passenger Vessels

Under current regulations, commercial vessels operating on U.S. territorial waters, except those vessels that operate wholly within State waters, are subject to Coast Guard jurisdiction. Vessels operating on State waters exclusively are subject to State oversight. States differ in the nature of their commercial vessel oversight, including commercial vessel classification criteria. Data on accidents involving commercial vessels subject to State oversight are maintained by the States.

Accidents Involving Incorrect Passenger Weight Assumptions

In its investigation of a January 2003 aircraft accident, the Safety Board noted deficiencies in the passenger weight standards that had been used to determine an aircraft's weight and balance.[38] Following the accident, the FAA asked operators of 10- to 19- seat aircraft (the size of aircraft involved in the accident) to obtain the actual weights of their passengers. Fifteen airlines operating the size of aircraft in question obtained passenger weights.

The results indicated that the average passenger weight ranged from 164 pounds in a sample of 16 adults to 200 pounds in a sample of over 3,000 adults, with the average weight most obtained about 190 pounds. As a result of these findings, the FAA informed the Safety Board that it intended to raise the average weight standard it permitted airlines

[38] *Loss of Pitch Control During Takeoff, Air Midwest Flight 5481, Raytheon (Beechcraft) 1900D, N233YV, Charlotte, North Carolina, January 8, 2003.* Aircraft Accident Report NTSB/AAR-04-01 (Washington, DC: National Transportation Safety Board, 2004).

to use in determining passenger weights to 195 pounds for each adult passenger, unless the airline could show that its average passenger weight was different. The change was to made through FAA Advisory Circular 120-27D,

On March 6, 2004, following the Baltimore capsizing of the pontoon vessel *Lady D*,[39] the Safety Board determined that the Coast Guard's passenger weight standard of 140 pounds for determining vessel stability (for vessels used exclusively on protected waters) posed a substantial safety risk for vessels carrying near the maximum number of permitted passengers. As a result, on December 20, 2004, the Safety Board issued Safety Recommendation M-04-04 to the Coast Guard, urging it to:

> Revise your guidance to Officers in Charge, Marine Inspection, to determine the maximum occupant capacity of small passenger pontoon vessels either (1) by dividing the vessel's simplified stability proof test weight by the per person weight allowance for an average adult stipulated in Federal Aviation Administration Advisory Circular 120-27D (174 pounds per person, assuming summer clothing and a 50-50 gender mix), or (2) by restricting (at the time of loading) the actual cumulative weight of passengers and crew to the vessel's simplified stability proof test weight.

In response to this recommendation, on April 7, 2005, the Coast Guard informed the Safety Board that it "partially concurred with this recommendation," noting that it agreed with the premise behind "option 1" but did not agree with "option 2." The Coast Guard stated, with regard to option 2:

> The actions necessary to implement a change to the standard weight per person used in the simplified stability proof test for small passenger pontoon vessels go

[39] *Capsizing of U.S. Small Passenger Vessel Lady D, Northwest Harbor, Baltimore, Maryland, March 6, 2004.* Marine Accident Report MAR/06-01 (Washington, DC: National Transportation Safety Board, 2006).

> beyond a simple revision of guidance to OCMIs. The current weight standards are set in regulation at 46 CFR 178.330 and extend to all other types of small passenger vessels as well. Therefore, any change would, and realistically should, affect all other small passenger vessel types. However, passenger weight is only one of many variables in our vessel stability calculations.

The Coast Guard added that it had chartered a working group to analyze the passenger weight issue and assess the potential impact of regulatory changes on vessel stability determinations. On March 7, 2006, in light of its investigation of the March 6, 2004, *Lady D* accident, the Safety Board wrote to the Coast Guard:

> The Safety Board agrees that the passenger weight standard should be revised in the stability criteria for all domestic passenger vessels and has classified Safety Recommendation M-04-4 "Closed—Superseded" in its final report on the capsizing of the *Lady D*. The 140-pound weight standard is used in the PSST (46 *Code of Federal Regulations* [CFR] 178.340), the SST (46 CFR 178.330) for monohull small passenger vessels on protected routes, and in Subchapter S stability calculations for passenger heel (46 CFR 171.050). Updating these standards will result in a more realistic assessment of the number of passengers a vessel can safely carry. Considering that a statistically representative average passenger weight is subject to change, the Coast Guard should also identify how best to address a weight standard that may change in the future.
>
> Updating the passenger weight standard will be a positive step toward ensuring that a vessel is certificated for the number of passengers it can safely carry. However, even if the number of passengers permitted is based on an increased average weight standard, the problem remains that a vessel can become overloaded if many of the passengers on board are heavier than the standard. Operators therefore need an easy way of identifying whether the passenger load they are intending to carry will compromise the stability of their vessels. If a mark were painted on the hull that corresponded to the waterline when the vessel was carrying maximum approved load, the vessel operator could easily determine whether the vessel was overloaded simply by observing the vessel's draft in

relation to that mark. The Coast Guard should identify a simple and reliable method for operators to determine that the maximum safe load for a small passenger vessel is not exceeded.

As a result, the Safety Board issued two recommendations concerning passenger vessel stability determinations to the Coast Guard:

M-06-5

Revise regulations to require that passenger capacity for domestic passenger vessels be calculated based on a statistically representative average passenger weight standard that is periodically updated.

M-06-6

Identify a method for determining the maximum safe load condition of a small passenger vessel at the time of loading, such as a mark on the side of the hull, and require that the vessel owners implement that method.

On April 26, 2006, the Coast Guard issued a voluntary interim measure for domestic vessel passenger weights,[40] partially in response to Safety Board recommendation M-04-04, issued after the March 6, 2004, *Lady D* accident, in which it called for small passenger vessel operators to take several voluntary measures. The Coast Guard also cited the *Ethan Allen* to justify its call for the voluntary interim measures, although it noted, with regard to this accident, that the vessel's "…Coast Guard COI expired in 1981, and [it] was not required to be inspected by the Coast Guard."

In the voluntary interim measure, the Coast Guard asked owners and operators of pontoon vessels and passenger vessels 64 feet in length or shorter that used the SST or pontoon vessel simplified stability test to reduce the total passenger capacity by using a

[40] *Federal Register*, vol. 71, no. 80 (April 26, 2006), pp. 24732-24735.

per passenger weight standard of 185 pounds in calculating the total weight permitted on board the vessel, instead of the lower weight standards. The Coast Guard said that if necessary, passengers should be weighed before boarding to verify that they meet the proposed revised weight standard.

The Coast Guard asked owners and operators of vessels for which stability was evaluated according to Coast Guard regulations in Subchapter S to review their stability guidance to ensure that they did not carry excessive passenger weight, or that increasing the per passenger weight to 185 pounds did not reduce vessel stability below Subchapter S requirements. It also asked owners and operators of all small passenger vessels:

- If certificated to operate only on protected waters, to avoid operating when small craft advisories are in effect, when wind gusts exceed 30 knots, waves are over 2 feet, or sustained winds exceed 18 knots.
- Notify the OCMI "if any significant structural or equipment changes have been made to the vessel" since stability was "evaluated by the owner and approved by the Coast Guard."

The Coast Guard also suggested that owners and operators may consider voluntarily reevaluating a vessel's stability using a per passenger weight of 185 pounds. Finally, the Coast Guard noted that it is in the process of preparing a rule that would apply to the same group of vessels addressed in the April 26, 2006, call for voluntary interim measures, that would amend its regulations to "address the stability issues caused by increases in passenger and vessel weight.

New York State Actions Since Accident

Shortly after the accident, the Governor of New York State proposed legislation to address deficiencies noted in the State's oversight of public vessels.[41] In particular, the Governor called for mandatory postaccident drug and alcohol testing of vessel operators and a reduction in passenger loads on public vessels to comply with the intent of Safety Recommendation M-04-04,[42] which called for increasing the passenger weight standard to 174 pounds when assessing vessel stability.

On March 2, 2006, the New York State Governor announced a comprehensive legislative effort to address additional deficiencies in the state's oversight of public vessels.[43] Among the initiatives was legislation requiring:

- Vessels carrying 20 or more passengers to have least two exits on each deck.
- Operators and engineers to crew vessels with the minimum number of crewmembers specified in the vessel COI, under penalty of suspension or revocation of licenses, with owners facing misdemeanor charges for violations.
- Owners to inform the State before modifying vessels in a way "that would affect the stability of the vessel…" with owners also facing misdemeanor charges for violations.
- Vessels carrying more than 49 passengers to be equipped with radar.

Several weeks thereafter, the Marine Services Unit of the State Office of Parks, Recreation and Historic Preservations, the office that oversees public vessel operations,

[41] See appendix C for more information.

[42] The recommendation was issued after the March 6, 2004, capsizing of the *Lady D.*

[43] See appendix B for more information.

circulated to public vessel owners and operators draft versions of two publications, "Technical Guidance for the Public Vessel Operators." One addressed operational issues, including bilge system alarm and pump requirements, and described ways to fulfill requirements for such safety features as carrying personal flotation devices, logbooks, emergency drills, fire-extinguishing systems, predeparture safety briefings, and navigation equipment. The other publication addressed simplified vessel stability tests. The drafts were circulated to give operators advance notice of the effects of the legislative changes that New York State Governor intended to implement.

Company Information

Shoreline Cruises began in 1974 when the owner began renting small recreational boats on Lake George. In 1979, the owner began Shoreline Cruises by conducting sightseeing tours of Lake George with the *Ethan Allen,* the *de Champlain,* and the *Algonquin*.

At the time of the accident, Shoreline Cruises operated those three vessels and two additional vessels from a shipbuilder. This shipbuilder, which had previously modified the canopy of *Ethan Allen* as well as that of the *de Champlain*, built the *Horicon,* an 85-foot vessel with a capacity of 200 passengers, that Shoreline acquired in 1988, and the *Adirondac*, a 400-passenger, 115-foot vessel that Shoreline acquired in 2004.

The owner estimated that the year before the accident, about 60,000 passengers had taken Shoreline Cruises sightseeing tours in all of its vessels. He believed that at the height of the tourist season in 2005, the company transported about 300 passengers a day

on sightseeing tours on its three small vessels, although he indicated that he would conduct a sightseeing cruise with as few as two passengers. The company recorded the number of passengers on its small vessels but did not retain those records and therefore had no accurate information available on the actual passenger loads on them.